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FABRICATION OF SEMI-AUTOMATIC BABY DIAPER MACHINE FOR RURAL TECHNOLOGY DEVELOPMENT

A PROJECT REPORT SUBMITTED BY

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BONAFIDE CERTIFICATE

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ABSTRACT

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So far no diaper machine is available in the market at low cost. A lot of sanitary napkin machines are available at low cost which are used by rural women in self help groups(SHG) to produce sanitary napkins at very low cost. It is because of the absence of diaper machines at low cost the cost of diaper is very high. As an aid to reduce the cost of diapers we have designed and fabricated a semi-automatic baby diaper machine at a very low manufacturing cost of Rs. 15000. This semi-automatic machine has three sections namely,

- Feeding section
- Cutting and sealing section
- Delivery section

Here the feeding and delivery sections are operated manually with the help of a handle. Whereas the cutting and sealing section is an automated one in which the cutting and sealing of the material assembly are done simultaneously. The performance of the machine has been analyzed from this machine and from this machine two diapers can be produced per minute.

In order to reduce the cost of the diaper further, we have modified the design of the current diaper which reduces the cost of diaper to less than Rs.2.

Thus the semi-automatic machine plays a major role in reducing the cost of the diapers so that the rural people can afford to these diapers and their hygiene level can be improved.

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INTRODUCTION

1. INTRODUCTION

The minimum cost of the currently available diaper machines is as high as Rs. 1 crore to Rs. 2 crore. This makes the cost of a diaper to be as high as Rs. 10. So the rural people are unable to afford these diapers. In order to reduce the cost of the diapers, we have designed and fabricated a semi-automatic baby diaper machine at a very low cost.

A diaper is an absorbent garment worn by individuals who are unable to control their bowel movements and who are unable to reach the toilet when needed. The word "diaper" originally referred to the type of cloth rather than its use. It is a term of pattern of repeated geometric shapes and later came to describe a white cotton or linen fabric with this pattern.

They are primarily worn by infants who are not potty trained. The disposable baby diapers are produced from fully automated diaper machines even at a very high speed of 800dpm. It is because of this speed and automation the cost of the machine is very high.

LITERATURE REVIEW

2. LITERATURE REVIEW

2.1. Diaper:

A diaper is an absorbent garment worn by individuals

- Who are unable to control their bowel movements, or
- Who are unable to reach the toilet when needed.

The word diaper originally referred to the type of cloth rather than its use; "diaper" was the term for a pattern of small repeated geometric shapes, and later came to describe a white cotton or linen fabric with this pattern.

Diapers are primarily worn by infants and children who are not yet potty trained or suffer from bed wetting. However, they can also be worn by adults who suffer from incontinence or in certain circumstances where access to a toilet is not available. These include some elderly people, those with a physical or mental disability, and people in extreme conditions such as astronauts.

2.2. Types of diapers:

2.2.1. Cloth diapers:

Cloth diapers are reusable and can be made from natural fibers, man made materials, or a combination of both. Industrial cotton that may be bleached white or left a natural color is used. Other natural

materials (often grown with pesticides), such as bamboo, unbleached hemp are also used. Manmade materials such as micro fiber toweling (for absorbency), or poly urethane laminate (for a water proof layer) may be used.

2.2.2. Disposable diapers:

As the name indicates, these diapers are not reusable and are disposed after its use.

Disposable diaper is made of an absorbent pad sandwiched between two sheets of fabric. The function of the pad is to absorb and retain body fluids, and the non-woven fabric gives the diaper a comfortable shape and helps to prevent leakage. The diapers are made by a multi-step process in which first the absorbent pad is made which is then attached to a permeable top sheet and impermeable bottom sheet. The other accessories are then sealed together by application of heat or ultrasonic vibrations.

There is no Indian Standards (BIS) specification for the manufacturing of disposable baby diapers. The average diaper is comprised of 43% of fluff pulp, 27% super absorbent polymer, 15 to 23% polypropylene/polyethylene, 5% adhesive and about 1% elastic. The nonwoven fabric required is of 20-25 gsm.

Diapers shall have high degree of softness. High absorbency while creating little or no irritation to the skin. Diapers shall absorb

30-60 gm wine without feeling wet. The desired rate of absorption should be very fast, i.e., within 5 to 7 seconds it should absorb.

- No leakage.
- No re-wetting and skin irritation.
- Comfortable and good fit.
- Environment friendly disposable.

They shall be made of clean, bacteria-free and highly absorbent cotton lap, cellulose pulp & tissue paper and both should not have an unpleasant odour when wet or dry. It should be easy to use.

2.2.3. Functions:

- Absorb body fluid.
- Retain body fluid inside the absorbent core.
- Isolate wetness from the baby's skin.
- Isolate other excretion from baby's environment (clothes, bed, etc)

2.3. Components of Disposable Diapers:

To prepare for what the future may hold, it is prudent to review the major components and their functionality in a typical modern diaper.

The major structural components are:

- Top sheet (cover stock).
- Acquisition and/or transport or distribution layer.
- Absorbent core.
- Back sheet.

Secondary component materials are:

- Barrier leg cuffs.
- Elastomeric materials.
- Hot melt glues.

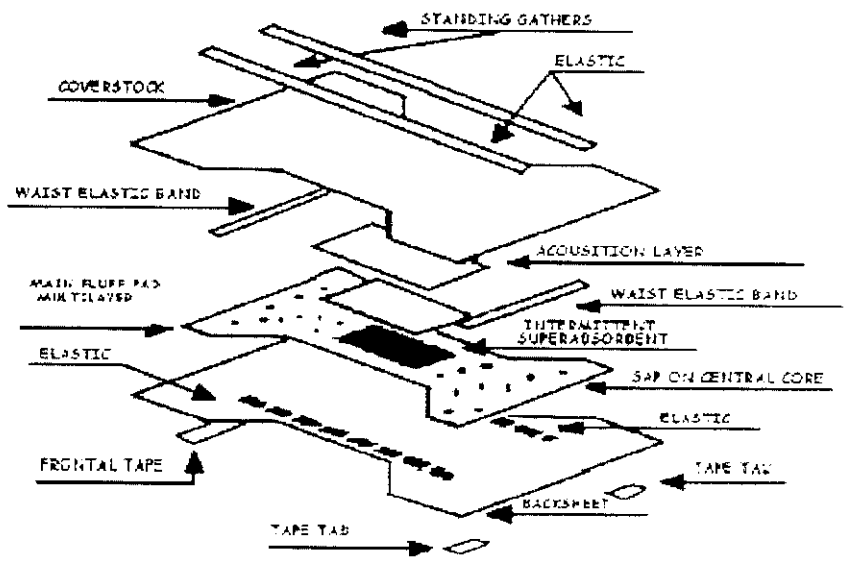


Fig.1. Sheets of a Disposable Diaper

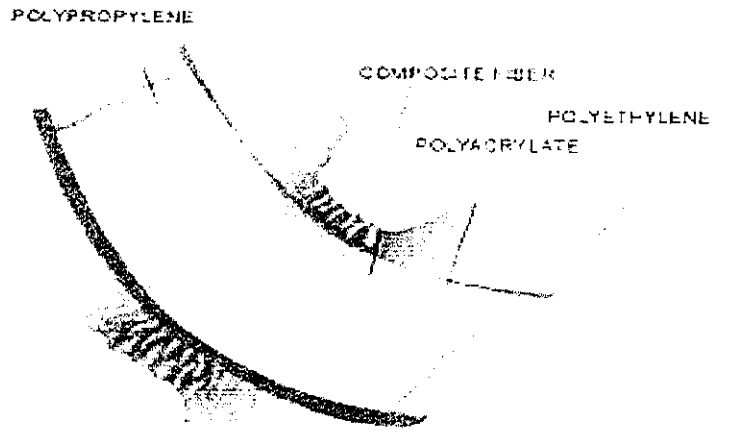


Fig.2. A Typical Disposable Diaper

2.3.1. Functions of various components:

- The top sheet closest to the skin is made of soft nonwoven fabric and transfers urine quickly to the layers underneath.
- The distribution layer receives the urine flow and transfers it on to the absorbent core.
- The absorbent core structure is the key component and is made out of a mixture of cellulose pulp and super absorbent polymers.
- The back sheet is typically made of breathable polyethylene film or a nonwoven and film composite which prevents wetness transfer to the film or cloth.

2.4. Cost of diapers:

2.4.1. In International market:

The costs calculated below for disposable, single-use diapers are based on two of the most popular brands from a store known for its value pricing.

The newborn package (up to 10 lb.):

It contains 48 diapers at $16.23, or **$0.34 each**. The average number of changes for a newborn is 12 to 16 per day for the first two weeks.

14 diapers x 7 days x 2 weeks = 196 diapers at $0.34 each = $66.64

The infant size 1 package (up to 14 lbs.):

It contains 104 diapers at **$ 0.22 each**. An average baby requires 10 to 12 changes per day for the first three months.

11 diapers x 30 days x 2.5 months = 825 diapers at $0.22 each = $181.50

The infant size 2 package (12-18 lbs.):

It contains 88 diapers at **$0.26 each**. An average baby who is three to six months old requires 10 to 12 changes a day.

11 diapers x 30 days x 3 months = 990 diapers at $0.26 each = $257.40

Mega-pack pricing was used for the balance of the packages, because mega-packs are the least expensive. Each mega-pack was $28.92 + $2.02 sales tax, for a total of $30.94 per package.

The infant size 3 package (16-18 lbs.):

It contains 96 diapers **$0.32 each**. A six- to nine-month-old baby requires eight to 10 changes per day.

9 diapers x 30 days x 3 months = 810 diapers at $0.32 each = $259.20

The infant size 4 package (22-27 lbs.):

It contains 64 diapers at **$0.37 each**. A nine- to 12-month-old child requires eight changes per day.

8 diapers x 30 days x 3 months = 720 diapers at $0.37 each = $266.40

The toddler size 5 package (over 27 lbs.):

It contains 58 diapers at **$0.41 each**. The average 12- to 18-month-old child requires six to eight changes a day.

7 diapers x 30 days x 6 months = 1,260 diapers at $0.41 each = $516.60

The child size 6 package (over 35 lbs.)

It contains 48 training diapers at $23.00, or **$0.45 each**. An average 18- to 30-month-old child requires six to eight changes per day.

7 diapers x 364 days = 2,548 diapers at $0.45 each = $1146.60

2.4.2. In Indian market:

The cost of few commercial, well known diapers in the Indian market are given below.

Table.1. Cost of Various Commercial Diapers

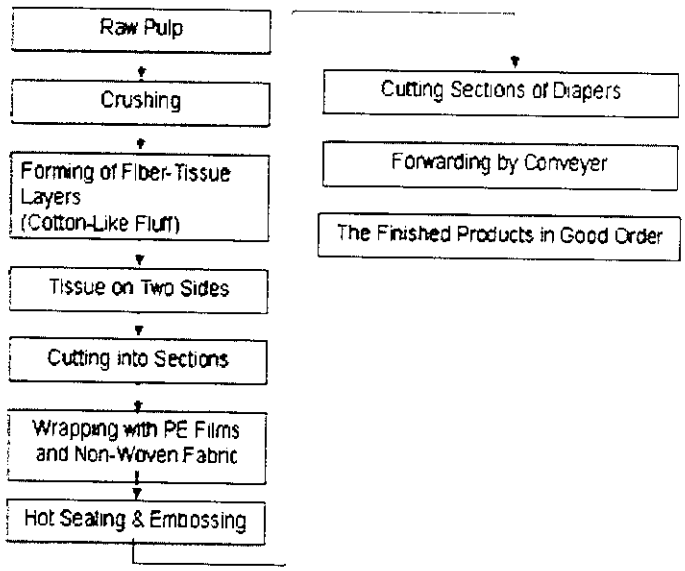
Product Name	No. of pieces per pack	Max. Retail Price (Rupees)	Single piece rate (Rupees)
Pampers	2	20	10
Baby soft	5	80	16
Snuggy	5	50	10
Huggies	5	80	16
Soft Love	4	65	16.25
Johnsons Baby	5	31	6.20

2.5. The Manufacturing process of Diaper:

2.5.1. Description of Manufacturing Process:

1. Sheets of rolled wood pulp are continuously and automatically fed to the pulp crusher, which crushes the supplied pulp into cotton-like fluff.
2. The fluffed pulp is then molded into strips.
3. Two absorbent layers of cotton are placed on two sides of the molded strip.
4. The entire strip is then cut into required lengths.
5. Waterproof polyethylene film is laid on the sides of the absorbent layers. The entire strip is then wrapped by a non-woven fabric, which holds the individual strip together. The strip is then processed by hot sealing and embossed with favorite figures.
6. The diapers, which are still joined together by the train diaper are forwarded by a conveyer and thereafter cut into separate pieces.
7. Each diaper is then placed into individual bags and arrayed in good order for packing.

2.5.2. Flow Chart of Process Sequence of Baby Diaper Manufacturing:



2.5.3. Formation of the absorbent pad:

The absorbent pad is formed on a movable conveyer belt that passes through a long "forming chamber." At various points in the chamber, pressurized nozzles spray either polymer particles or fibrous material onto the conveyor surface. The bottom of the conveyor is perforated, and as the pad material is sprayed onto the belt, a vacuum is applied from below so that the fibers are pulled down to form a flat pad.

At least two methods have been employed to incorporate absorbent polymers into the pad. In one method the polymer is injected into the same feed stock that supplies the fibers. This method produces a pad

that has absorbent polymer dispersed evenly throughout its entire length, width, and thickness. The problems associated with method are that loss of absorbent may occur because the fine particles are pulled through the perforations in the conveyor by the vacuum. It is therefore expensive and messy. This method also causes the pad to absorb unevenly since absorbent is lost from only one side and not the other.

A second method of applying polymer and fiber involves application of the absorbent material onto the top surface of the pad after it has been formed. This method produces a pad which has absorbent material concentrated on its top side and does not have much absorbency throughout the pad. Another disadvantage is that a pad made in

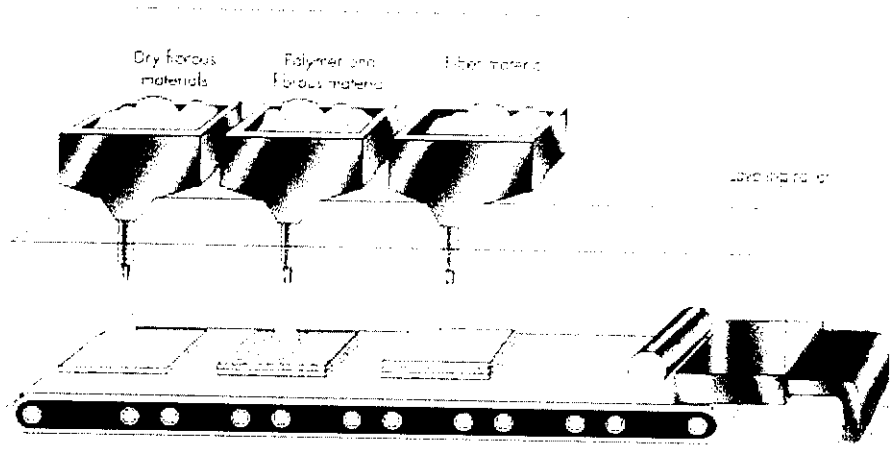


Fig.3. Manufacturing process of the absorbent pad

this way may lose some of the polymer applied to its surface. Furthermore, this approach tends to cause gel blocking, since all the absorbent is on the outside of the pad. The moisture gets trapped in this outer layer and does not have a chance to diffuse to the center. This blockage holds moisture against the skin and can lead to discomfort for the wearer.

These problems are solved by controlling the mixture polymer and fibrous material. Multiple spray dispensers are used to apply several layers of polymer and fiber. As the fiber is drawn into the chamber and the bottom of the pad is formed, a portion of the polymer is added to the mix to form a layer of combined polymer and fiber. Then more pure fiber is pulled on top to give a sandwich effect. This formation creates a pad with the absorbent polymer confined to its center, surrounded by fibrous material. Gel blockage is not a problem because the polymer is concentrated at core of pad. It also solves the problem of particle loss since all the absorbent is surrounded by fibrous material. Finally, this process is more cost effective because it distributes the polymer just where it is needed.

After the pad has received a full dose of fiber and polymer, it proceeds down the conveyor path to a leveling roller near the outlet of the forming chamber. This roller removes a portion of the fiber at the top of the pad to make it a uniform thickness. The pad then moves by the conveyor through the outlet for subsequent operations to form the competed diaper.

2.5.4. Preparation of the nonwoven

Sheets of nonwoven fabric are formed from plastic resin using the melt blown process as described above. These sheets are produced as a wide roll known as a "web," which is then cut to the appropriate width for use in diapers. There is a web for the top sheet and another for the bottom sheet. It should be noted that this step does not necessarily occur in sequence after pad formation because the nonwoven fabrics are often made in a separate location. When the manufacturer is ready to initiate diaper production these large bolts of fabric are connected to special roller equipment that feeds fabric to the assembly line.

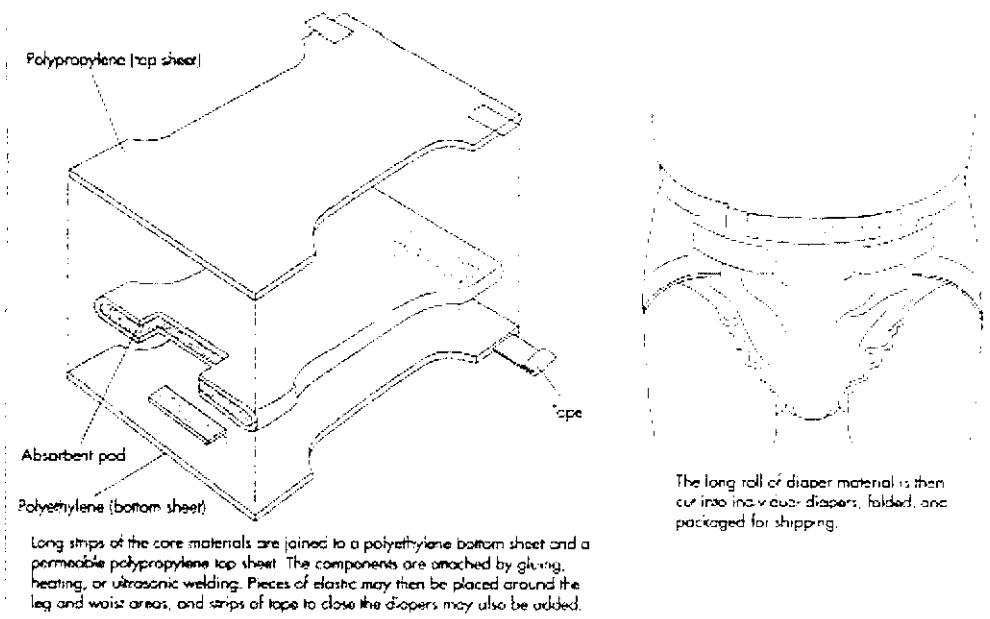


Fig.4. Assembly of Diaper Components

At some point in the process, stretched elastic bands are attached to the backing sheet with adhesive. After the diaper is assembled, these elastic bands contract and gather the diaper together to ensure a snug fit and limit leakage.

2.5.5. Assembly of the components:

At this point in the process there are still three separate components, the absorbent pad, the top sheet, and the backing sheet. These three components are in long strips and must be joined together and cut into diaper-sized units. This is accomplished by feeding the absorbent pad onto a conveyor with the polyethylene bottom sheet. The polypropylene top sheet is then fed into place, and the compiled sheets are joined by gluing, heating, or ultrasonic welding. The assembled diaper may have other attachments, such as strips of tape or Velcro™, which act as closures.

The long roll is then cut into individual diapers, folded, and packaged for shipping.

2.6. Diaper machines:

2.6.1. Major converting plant & machinery equipment for diaper production

- Raw material unwinder.
- Pulp grinder.
- Fluff drum forming system.
- Fluff processing.
- Super absorbent polymer applicator.
- Fluted elastic waist band applicator
- Fluff leg cuff applicator.
- Hot melt glue applicator.
- Tape detector.
- Compressing unit.
- Poly-cutting system.
- Stacker unit.
- Mini scutcher.

2.6.2. Parameters of various models of diaper machines:

a) JWC-NK500:

Model: JWC-NK500-SV

Brand: JWC

Make: China

Product description:

1) Full servo motors driving, conveying accuracy is high.32 sets of moving control servomotor (Bosch Rexroth, which made in Germany) or Mitsubishi made in Japan (option), 14 sets Mitsubishi **transducers** use for unwinding conversion system with tension control.

2) Constant tension controlling, roller center unwinding by driving

3) SAP put in fixed amount

4) High speed automatic changing rollers by connecting raw materials.

5) Air operated axis makes feeding easy.

6) Auto-inspection and rejection on line function.

7) Automatic web-guider

8) Touchable screen controlling platform, to provide the service between man and machine by pictures file.

9) Many specifications of fluff pulp, drum formation.

10) Leg cuff and elastic waistband structures.

11) Security door adopts the alnico framework with steeled door.

Option Devices:

1) Dust collect and low noise pipe system
2) Full servo horizontal type code machine/automatic feeding packing bags structure
3) Attached use hot melt applicators of Nordson or ITW, which made in USA.

Main technical parameters.

1) Designed speed 200/min
2) Running speed: 450pcs/min(S size)
3) Qualified rate: 97 %(based on 7.5 hours, rate of qualified amount and total amount, excluding caused by glue applicators failure)
4)Efficiency: ≥85 %(based on 7.5 hours, practical productivity and theory productivity)
5) Capacity: 360kw (including glue machine, double drums formation); 300KW (including glue machine, single drum formation)
6) Electricity: 3 phases 4 lines 380v±5%, 50HZ (earth line)
7) The lowest air pressure: 6 kg/cm^2
8) Total weight: about 60000 kg
9) Noise: <85db (A)
10) Main machine overall dimensions: 20x2x2.8M (LxWxH)
11) Machine taking total space: 28x8x3.5M (Lawks) (including outer attached equipment)

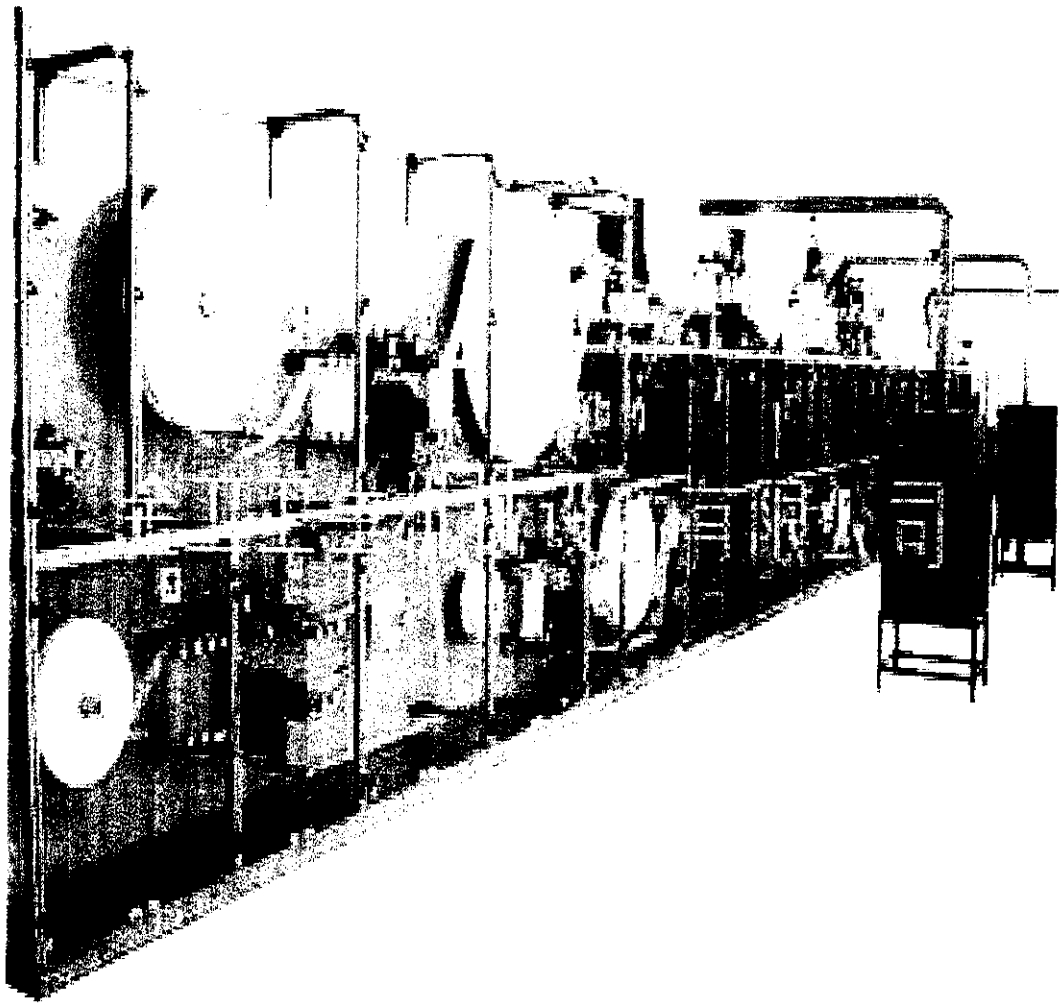


Fig.5. JWC-NK500-SV

b) JWC-LKA:

MODEL: JWC-LKA

BRAND: JWC

MAKE: CHINA

Product description:

1. The fluff adopts forming drum or aggregate pulp supply unit. The functions are complete. It can produce diapers of economic type and high grade. It can produce four types of products (XL, L, M, and S) with a few parts changed.

2. It has waistband, frontal tape and side tape devices.

3. Both sides with leak proof cuffs. Material for stereo shield is cut and shaped by hot press on the equipment. It adheres to elastic ribbon to be formed for side leakage proof.

4. The machine can produce both T-shaped and I-shaped diapers.

5. The phase may be adjusted without stopping machine.

6. Main raw materials are used with unwound, tension control system.

7. After the side arcs are shaped, the wings will be tri-folded lengthwise. The diaper pads will be output in line and easy for packing.

8. It can produce 3 sizes of diapers and diaper pads.

Main Technical Parameters:

1. Type: JWC-LKA
2. Design output: 100-150 pieces/min
3. Installation capacity: 59KW (380V 50Hz)
4. Overall dimension: 16.5m*1.9m*2.7m (length*width*height)
5. Total weight: 18T
6.Equipment specification (length*width)

S - 380*270mm M - 450*310mm

L - 515*330mm XL - 540*340 mm

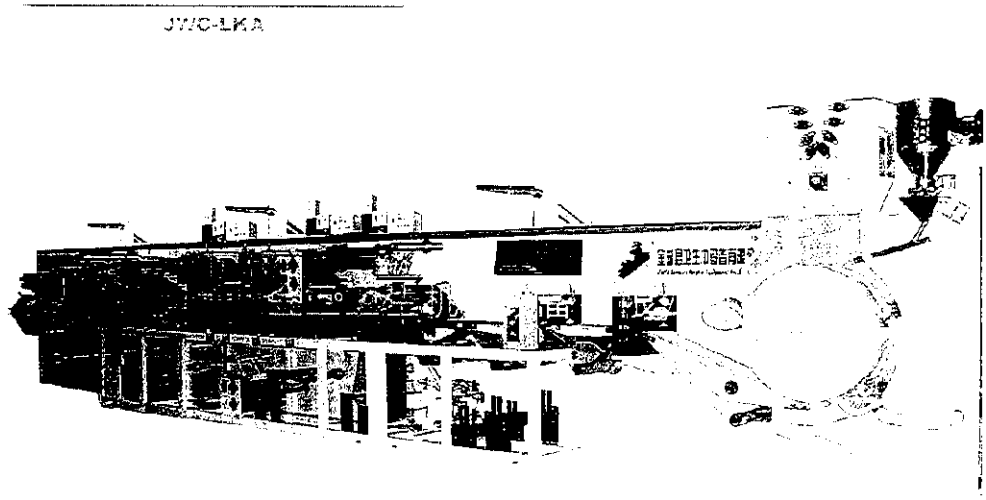


Fig.6. JWC-LKA

c) HX-160:

MODEL: HX-160

MAKE: CHINA

Main Functions:

1. Paper pulp and tissue paper being formed by web-press, it can avoid cotton core broken or re-movement.
2. Materials for stereo-protection are cut and heat pressed on the equipment. The elastic ribbon can be used to form stereo-protection. So it can be shrunk.

3. Elastic is covered up in the middle of side. It can be shrunk.

4. Frontal waist tape and the two-side tape are cut on the equipment. And materials' transfer place is very correct.

5. After being arc-cut on sides, double wings fold and 3-fold, the products may be rotated for and stacked in line.

6. All relative parts have differential device for phase adjustment during operation.

7. Sap power can be applied at a constant amount or mixed with nap. So that it can avoid cotton core shedding.

8. Synchronous belt is used in each working parts, main driving system adopts rigid axle, high mechanical efficiency, and stable operation.

9. Bevel gear right-angle box is adopted on relative driving part to prolong the equipment's life time and improve its efficiency.

Major Technical Parameters:

1. Production Speed: 150-200pcs/min

2. Power: 85kw (380V 50Hz) excluding glue machine which are necessary for the complete production.

3. Overall: L*W*H 15600*2400*2800mm

4. Weight: About 29.5 T

5. Specification of product (L*W)

Small: 383*280mm

Middle: 450*320mm

Large: 500*340mm

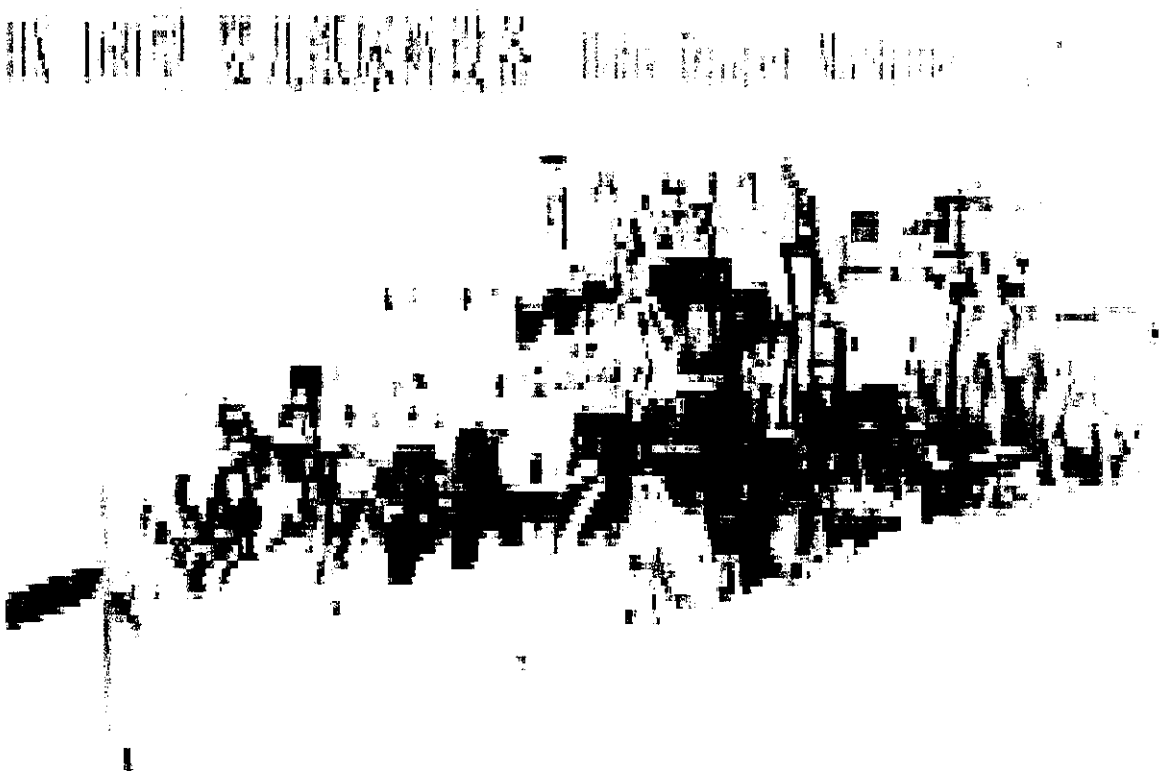


Fig.7. HX-160

d) MH-3Y:

MODEL: MH- 3Y

MAKE: CHINA

Product Description:

1. The machine can turn out diaper and diaper pad of extra large, large, medium and small sizes.
2. Adopt Mitsubishi PLC control system.
3. Safe-guard system.
4. Semi-auto splicing material without stopping the machine, without reducing the working speed.
5. Auto detecting and rejecting of defective products and trim remove.
6. Human machine interface is controlled by touch screen.
7. Most electrical components are of international brands

Technical Parameters:

8. Electric source: 380V, 50Hz
9. Total power: 90kW
10. Production capacity: 250 – 280pcs/min
11. Product dimension:

A) XL: 520 x 330mm.

B) Large: 480 x 320mm.

C) Medium: 430 x 320mm.

D) Small: 380 x 280mm.

12. Finished percent: 95%.

13. Machine dimension (L x W x H): 20.5 x 1.5 x 2.8m.

14. Weight: 22T.

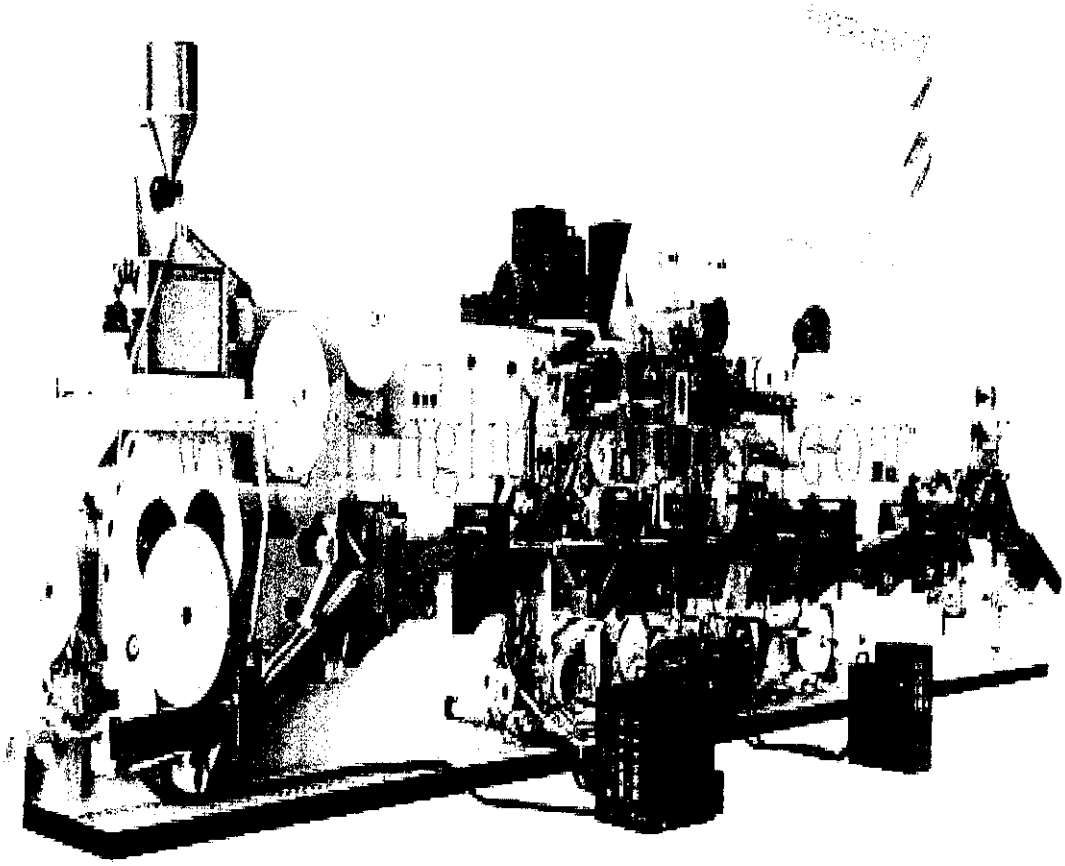


Fig.8. MH-3Y

e) SM-GSNK250:

Product description:

1.Saw mill device for machine can mill untreated roll pulp
2.Top sheet compound mechanism
3.With warning function for SAP with lower place
4.With front waist tape, sides waist tape, elastic waist tape mechanism
5.Elastic rubber for leg applying is auto-winder control
6.Standing cuffs mechanism
7.Main material with constant tension control auto-winder, automatic splicing and imported web guide
8.With warning and shut down function by PLC control, and material end detection
9.Driven by frequency. And with PLC control and touching screen
10.Tri-fold arranging out

Technical parameters:

1. Supply: 380V 50HZ
2.Power:125KW (excluding hot melt machine and air compressor) (for reference)
3.Normal capacity: 250pcs/min (M size)
4.Qualification rate: 97%
5.Outside dimension (m):19x7x3 (L x W x H) (for reference)

Fig.9. SM-GSNK250

f) NYHM-B500:

Model: NYHM-B500-SV

Brand: NYHM

Type: Servo-motor Control Baby Diaper Machine

Product Specifications:

1. Servo-motor control.
2. Constant tension auto-unwinding system.
3. Fully speed auto splicing without shut down.
4. Auto-inspection and rejection on line function.
5. with web guide device.
6. Touching screen operation with figure.
7. SAP auto-lifted on line inspect device.
8. Standing cuffs and waist tape apply device.
9. Back sheet compound online device.
10. Precision CNC operation for parts
11. Dust collect and low noise pipe system
12. Stacker for product packing into bag

Technical parameters:

1. Supply: 380V, 50HZ
2. Power: 220KW (excluding hot melt applicators and air compressor)
3. Capacity: 450pcs/min (M size)
4. Production capacity rate: ¡Ý85%
5. Qualification rate: ¡Ý97%
6. Outside dimensions (m): 30¡Á8¡Á2.6 (L¡ÁW¡ÁH)(for reference)

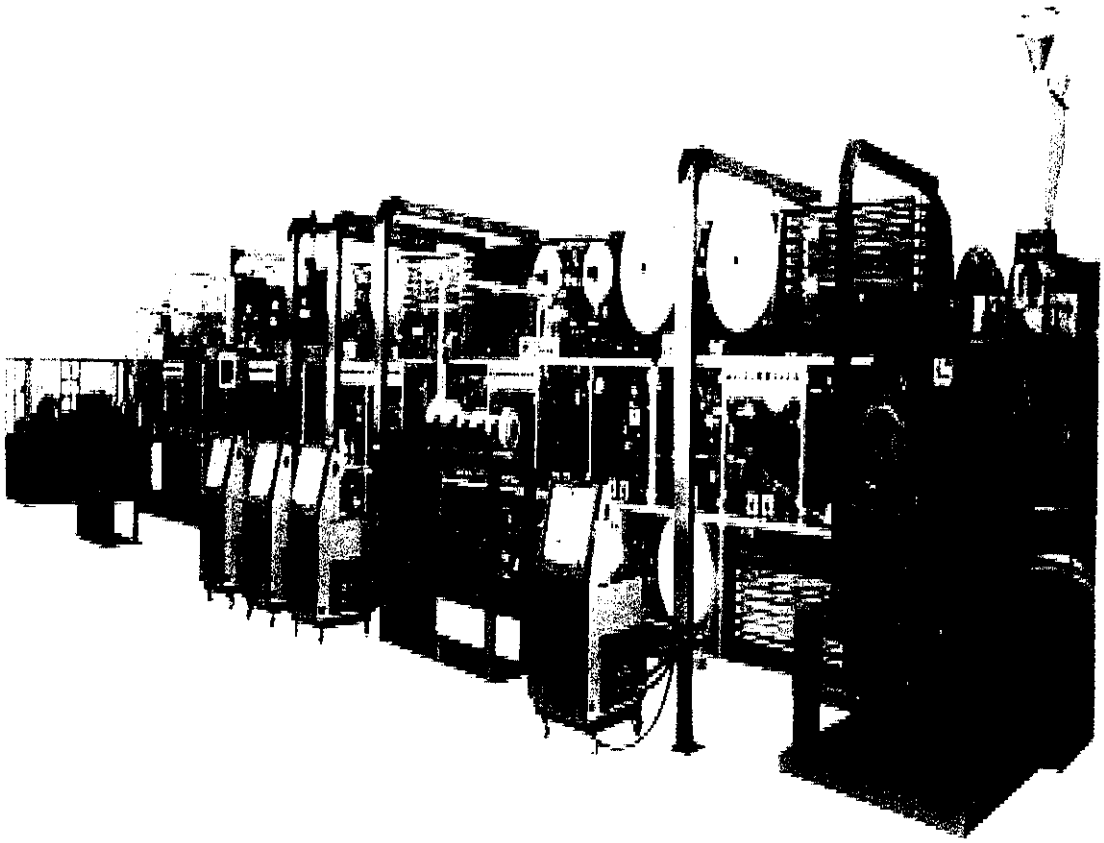


Fig.10. NYHM-B500-SV

2.7. Machine cost:

There is a huge range of pricing for diaper machines, depending on the product structure, product features and machine speed.

The common range of prices for European or US diaper machines

Would be from $1,000,000 to $3,000,000. You can pay more. Chinese machines can cost from $120,000 to $1,200,000.

Second hand European and US Machines are often available, and would range from $300,000 to $1,000,000.

2.7.1. Typical Machine Costs:

All high speed disposables machines are purpose-made to suit exact client requirements. They vary greatly in price based on the following main parameters:

- Machine speed
- Product features
- Product quality

The following tables give **approximate** minimum costs of typical baby diaper machines.

Table.2. Various Machines' Costs

	Machine speed	Product type	Minimum Cost
Baby Diaper Machine	**Slow speed - 100dp/m**	**Economy**	**$120k**
	Medium Speed -250dpm	**Medium /Premium**	**$400k**
	High speed - 400dpm	**Premium**	**$1,400k**
	Top speed - 800dpm	**Premium**	**$2,000k**

2.7.2. Cost of various models of diaper machines:

Table.3. Cost of Various Models of Diaper Machines

s.no.	Machine model	Approximate cost
1.	JWC-NK500	$690000
2.	JWC-NK500-SV	$659000
3.	JWC-LKA	$148000
4.	JWC-LKB	$138470
5.	JWC-NK200	$228400
6.	JWC-NK300	$284600
7.	MH-3Y	$100000

METHODOLOGY

3. Methodology:

3.1. Objective of our Project:

1. To design and fabricate a cost-effective semi-automatic baby diaper machine.

2. To produce cost-effective diapers out of the semi-automatic machine.

3. To make performance analysis and cost analysis of the semi-automatic baby diaper machine.

3.2. Passage of material:

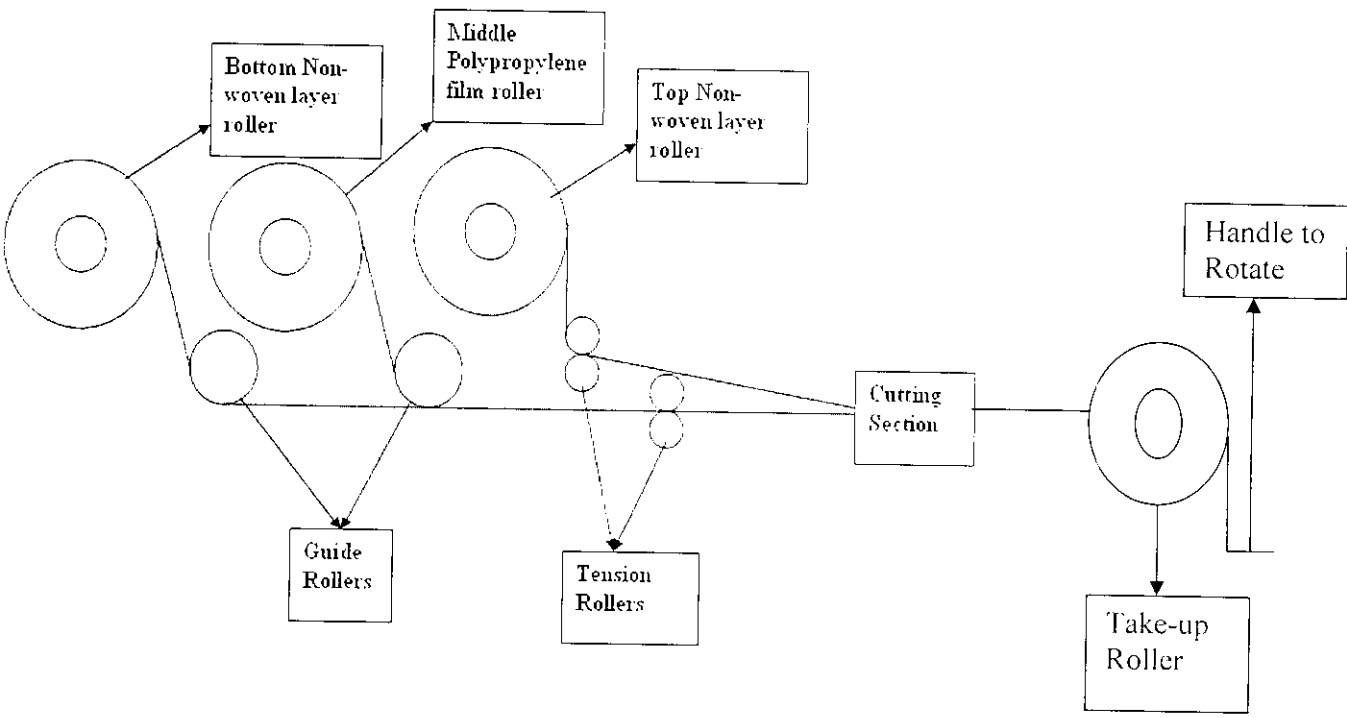
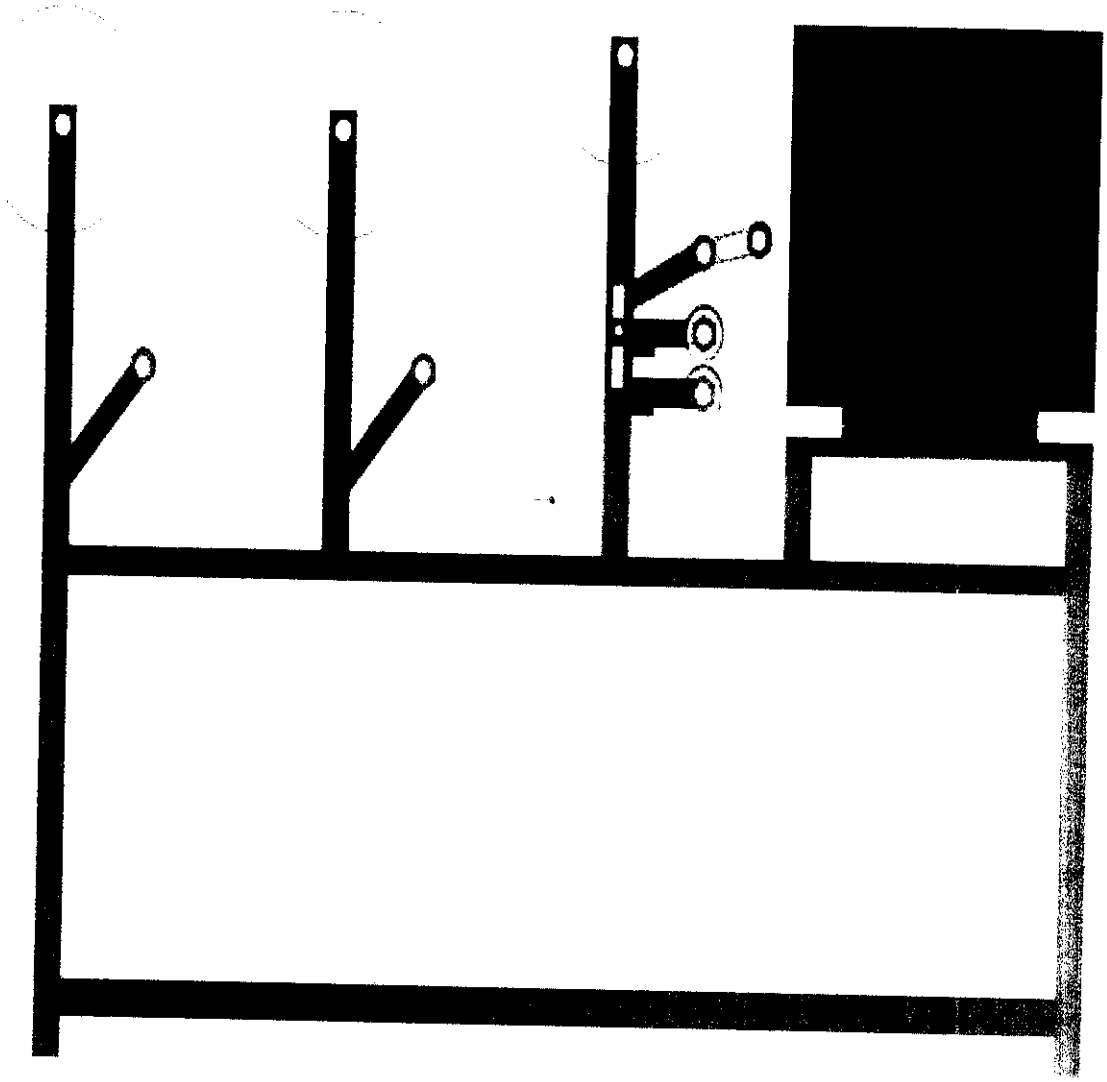


Fig.11. Material flow through the Machine

Diagram of the proposed Semi-automatic Diaper machine



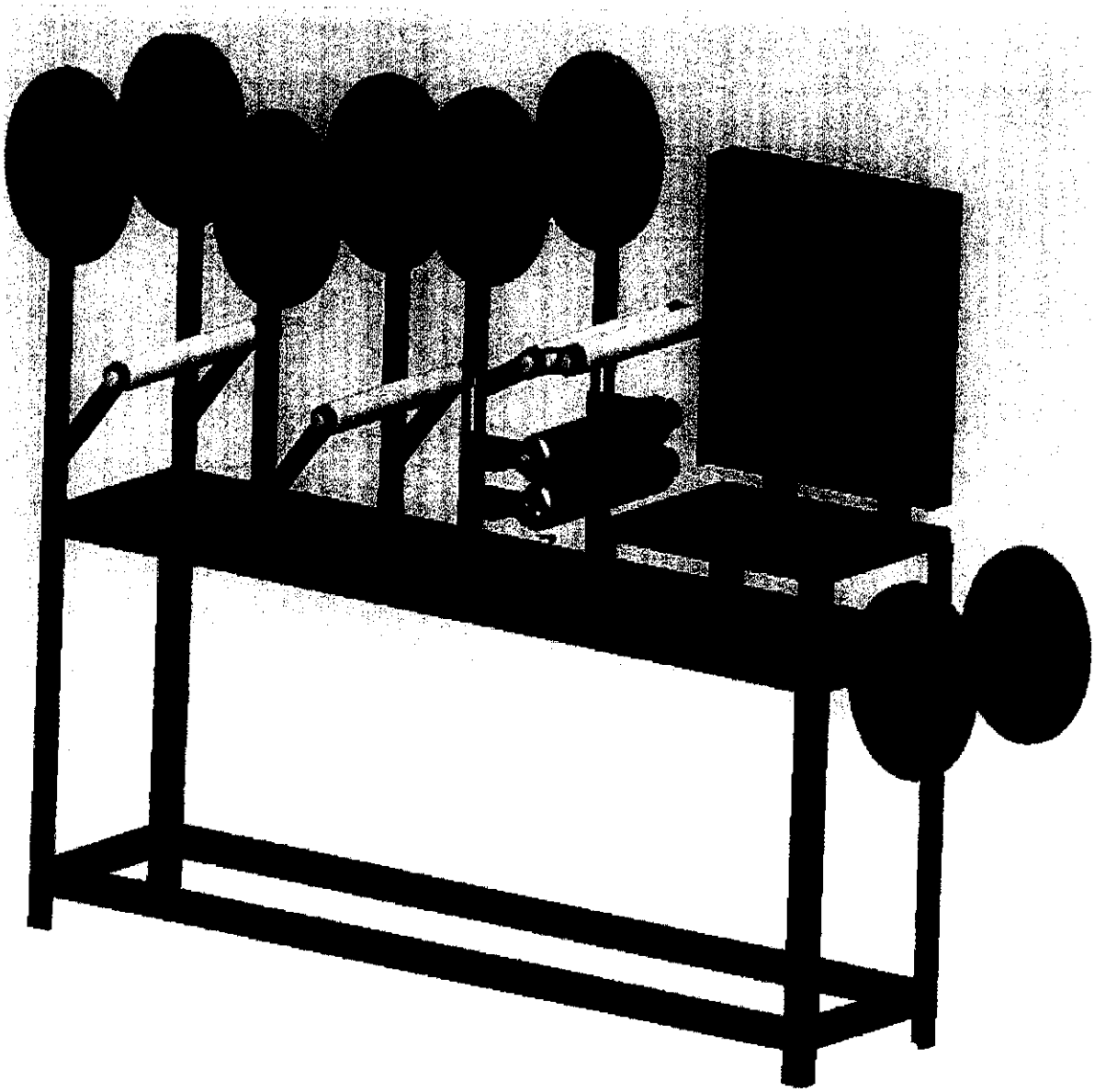


Fig.13. Isometric view

3.2.1. Feeding section:

- The back roller has the spool containing the polypropylene nonwoven which forms the bottom layer of the diaper.
- The middle roller has the spool containing the water impermeable polypropylene film which forms the layer which is next to the bottom layer.
- The front roller has the spool containing the polypropylene nonwoven which forms the topmost layer of the diaper.
- The materials from the back and middle rollers pass through the corresponding guide rollers and are pressed together between a set of pressure or tension rollers before passing through the cutting sealing section.
- Whereas the material from the front roller passes between a different set of pressure rollers before passing through the cutting section.
- The **unwinding** of the materials from the spools is done **manually.**
- Once the materials from the back and middle rollers are unwound and placed on the cutting and sealing platform, the prepared absorbent core is placed on them.
- Now the topmost layer is also unwound from the spool and placed above the absorbent core.
- The entire assembly is now cut into the required shape and sealed simultaneously and automatically.

- Once it is cut and sealed the diaper is taken out.

3.2.2. Delivery section:

- The waste material is wound on to the delivery roller by means of a handle which is rotated clock wise.

3.2.3. Cutting Section:

- The cutting and sealing section is said to be the automatic part of the machine.
- Here cutting and sealing of the material assembly is done simultaneously.

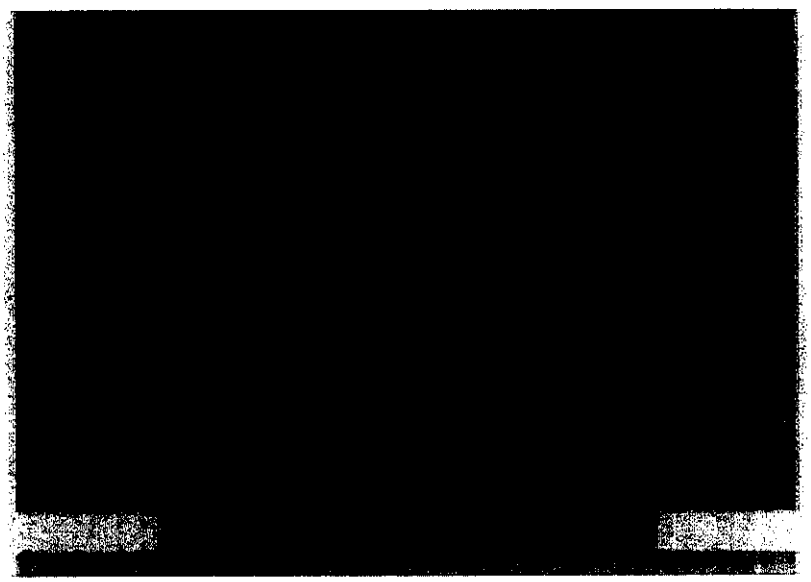


Fig.14. cutting profile

- The **principle** behind this is that once the material is **heated** to a particular temperature (say the melting point), it **melts** and hence the layers get stuck to each other at this temperature.
- The material assembly is heated by using copper heating element which has already been bent into the required diaper shape.
- Thus the material assembly is cut and sealed automatically and simultaneously.

The Cutting Section of the machine works with the help of electric current and the basic circuit involved in it is shown below:

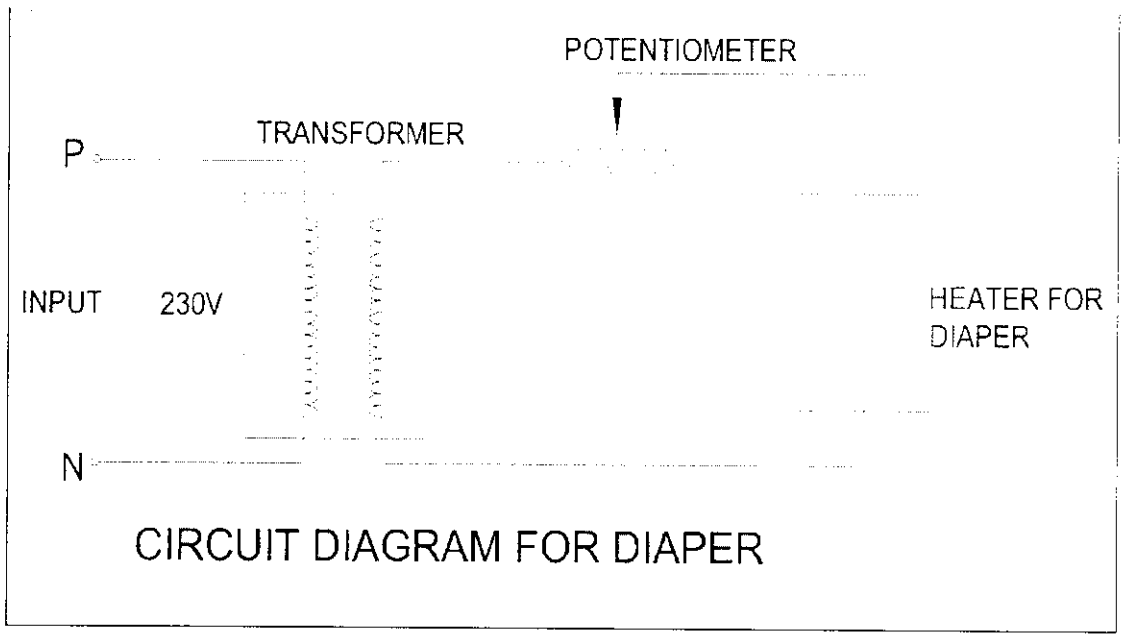


Fig.15. Basic circuit used in the cutting section

- This shows only the basic circuit involved in it.
- The input of the transformer is connected to the main supply and the output is connected to the heating element.
- Capacity of the transformer used here is **230V, 30Hz**, DC.
- Actually a **temperature controller** is used so that once the preset temperature is reached the circuit breaks and restricts the flow of current to the heating element.
- And if the temperature falls below the tolerance limit the circuit gets closed and electric current flows through the heating element.
- But the temperature controller doesn't have the capacity to withstand large current from the transformer. So a conduct circuit is used to connect the controller with the transformer.
- A thermocouple is used to connect the heating element with the circuit.

The overall circuit showing the connection of temperature controller with the transformer through the conduct circuit is shown below.

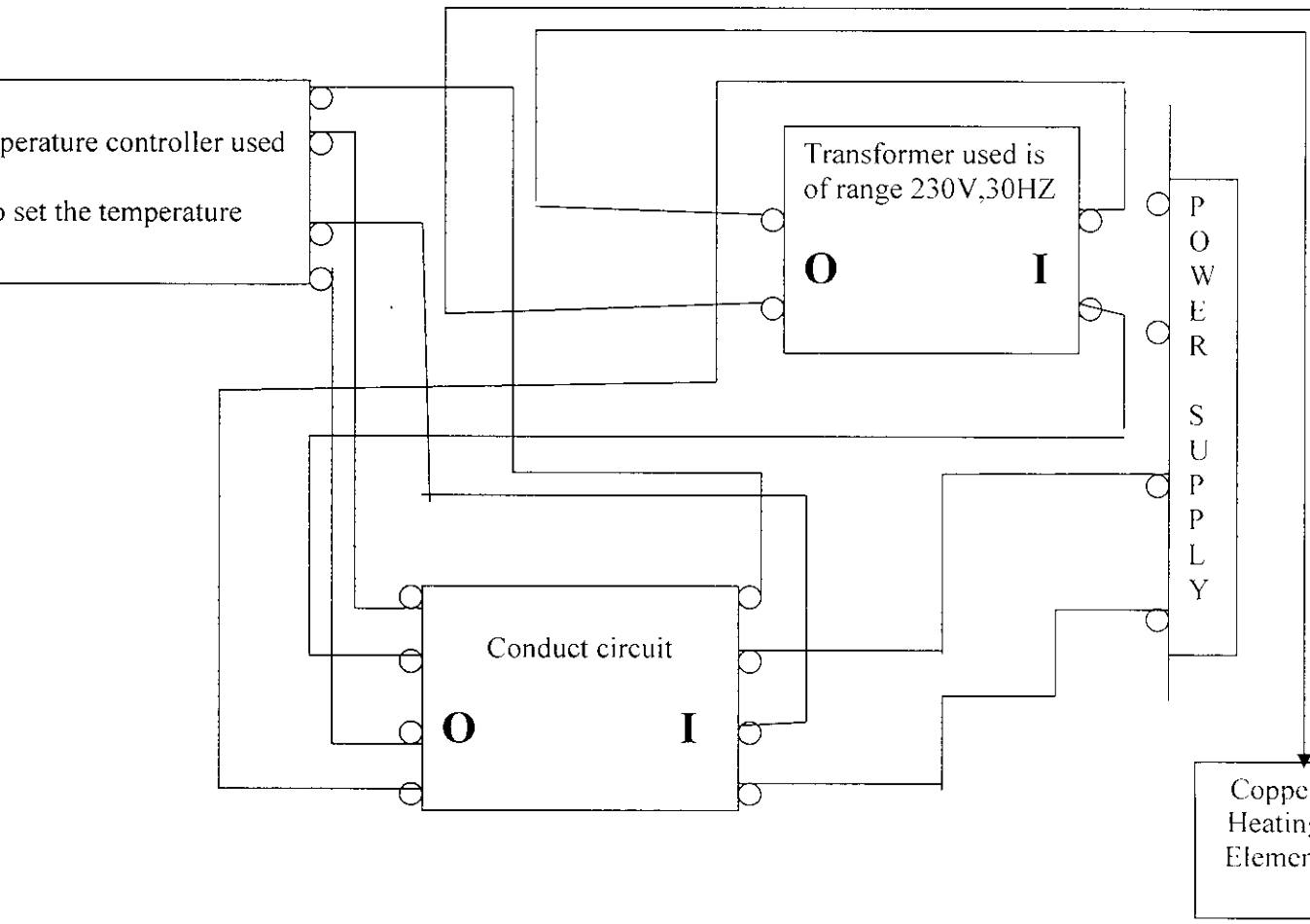


Fig.16. Circuit of Temperature Controller (Control Box)

3.3. Materials:

3.3.1. Materials used in the Diaper:

- Bottom layer - Polypropylene nonwoven
- Impermeable film - Polypropylene film
- Absorbent core - Wood pulp
- Top layer - Polypropylene nonwoven
- Elastic thread - Covered lycra

The elastic thread is stitched on the top of the diaper. The stitching operation is involved mainly to reduce the cost of the diaper as the cost of adhesive and its gluing technique is quite higher.

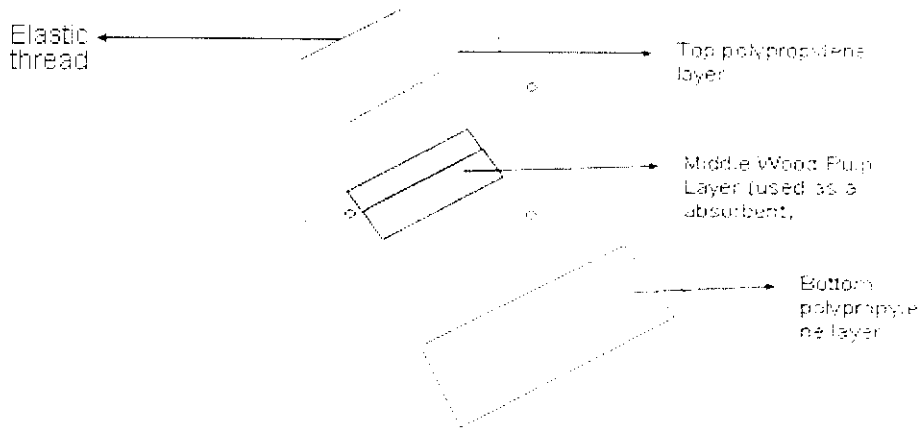


Fig.17. Component Structure of the Developed Diaper

- The top layer of the nonwoven serves as the recipient and transfers the liquid on to the absorbent core.

- The core forms the main part of the diaper as it absorbs and holds the liquid with it.
- The water impermeable polypropylene film prevents any leakage.
- The bottom layer of nonwoven serves to hold the above components.
- The elastic thread holds the diaper around the legs of the baby and helps for the free movement of the legs.
- The sticker is used to fit the diaper around the baby's waist.

3.3.2. Diaper Dimensions:

- Length - 43.5 cm
- Width - 35 cm

3.3.3. Materials used in the Machine:

- Frame of the machine - Iron
- Spools:

  a) Shaft - PVC

  b) Flange - Wood

- Guide rollers:

  a) Outer layer - PVC

  b) Inner layer - Wood

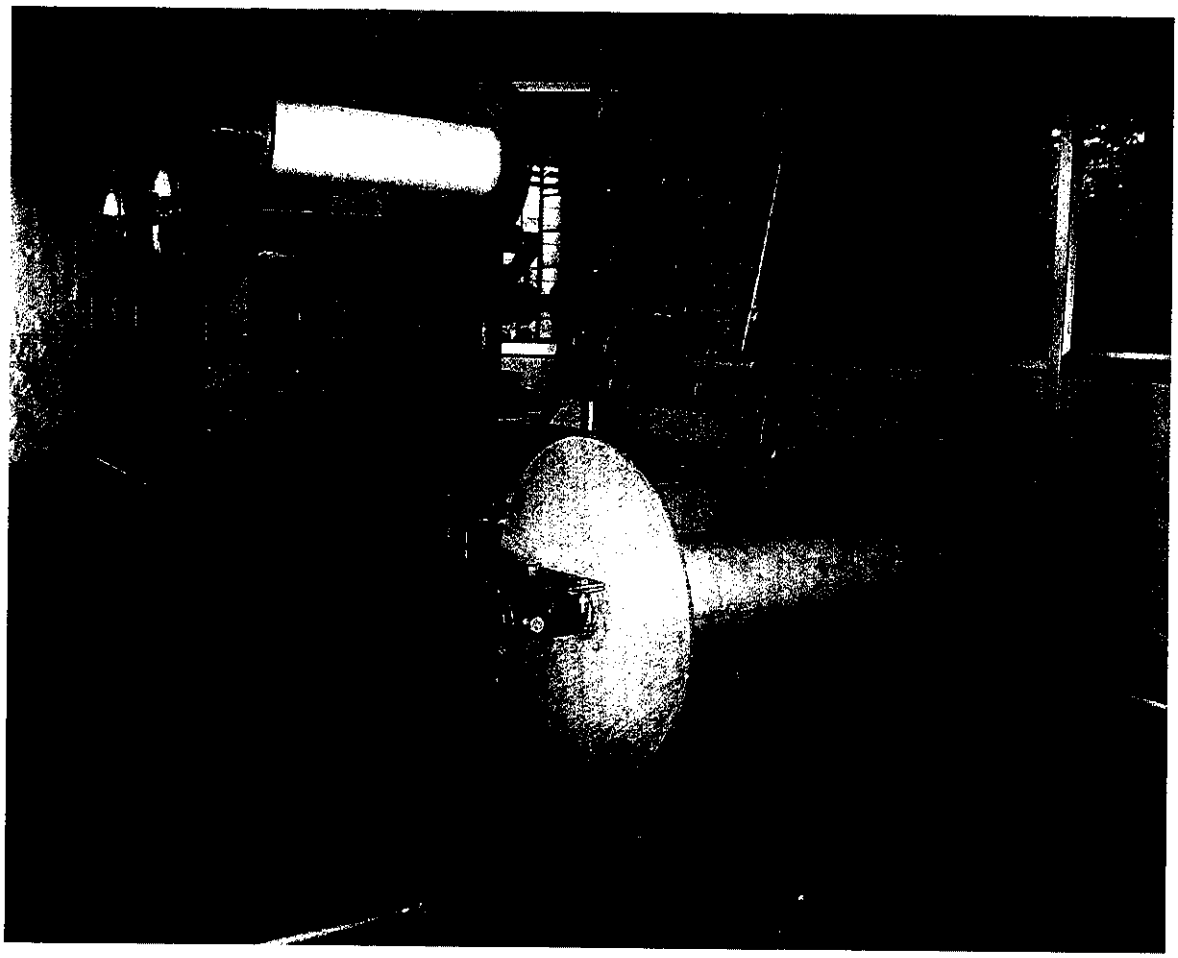
- Cutting and sealing section:

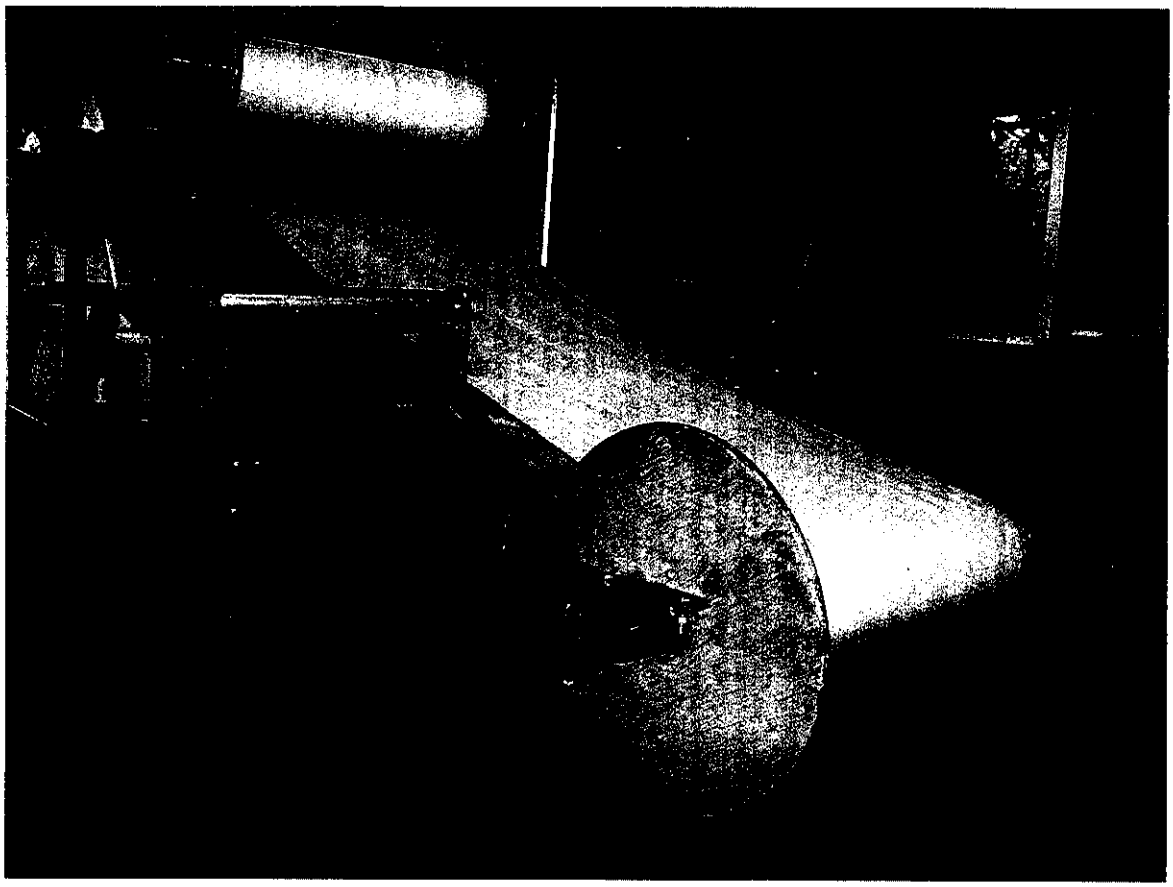
a) Frame	-	Iron
b) Heating element	-	Copper
c) Transformer	-	230V, 30Hz
d) Temperature controller range	-	1200 C

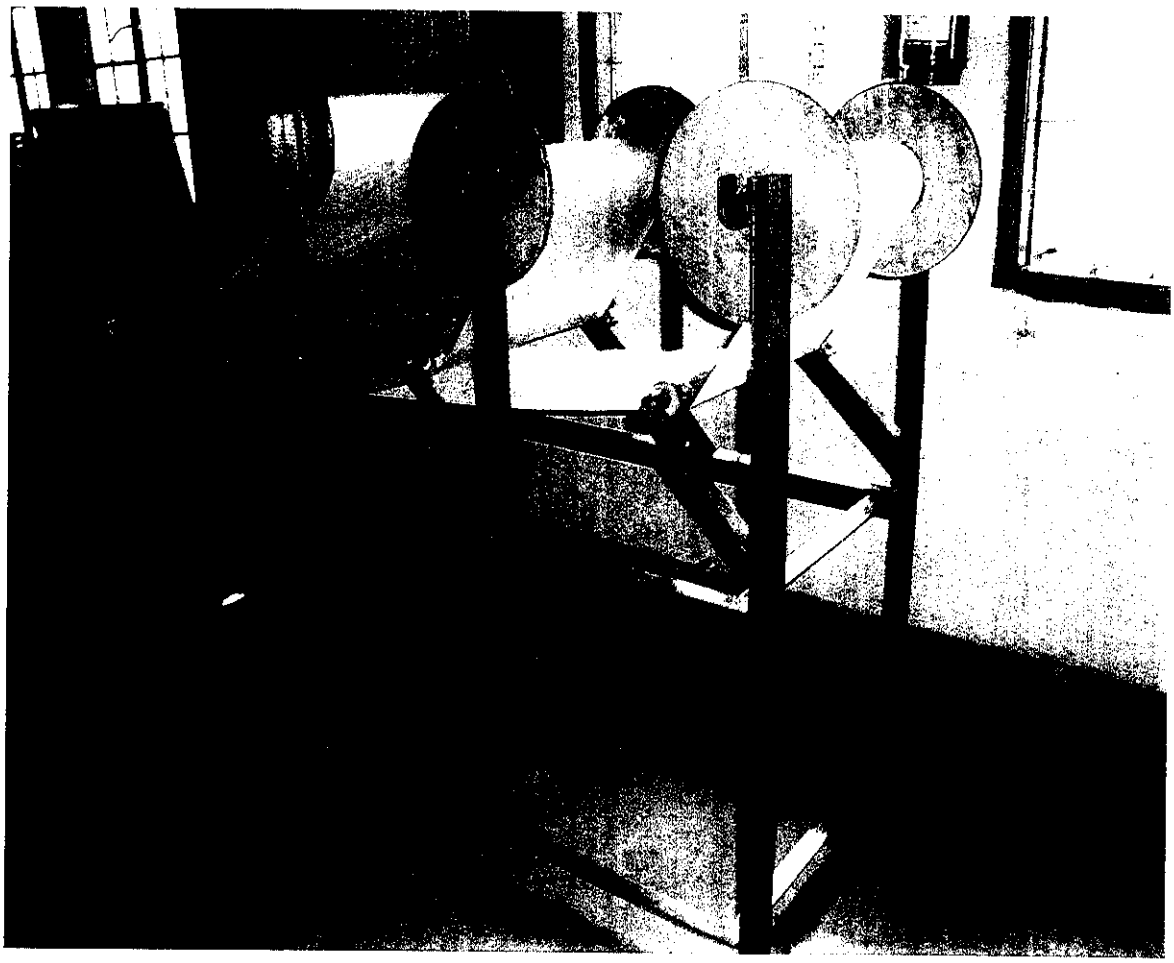
RESULTS

4. Results

4.1. Pictures of the Produced Semi-automatic Diaper Machine







4.2. Machine particulars

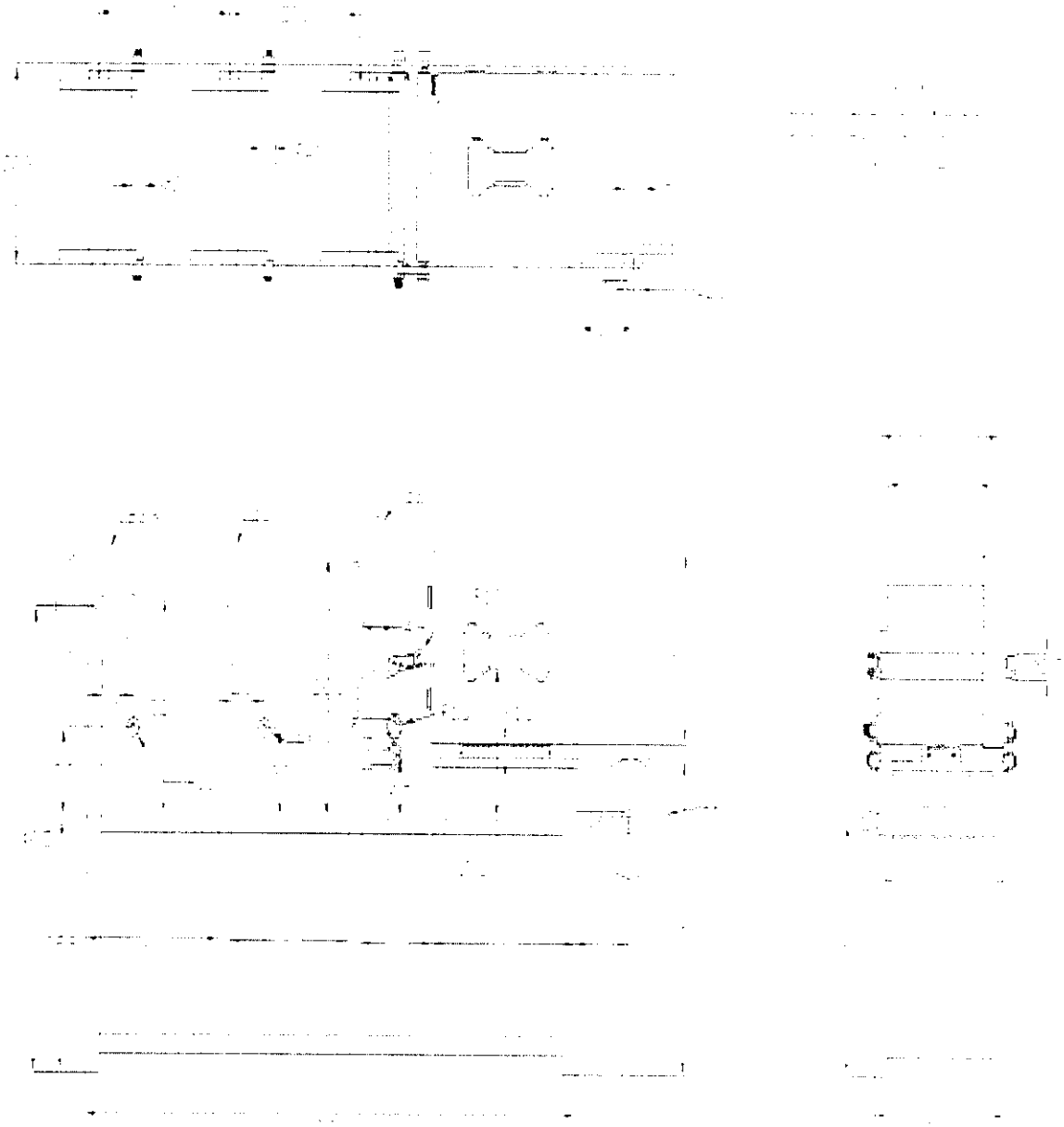


Fig.18. Machine Dimensions

4.3. Machine Cost:

Table.5. Cost of Various Sections of the Machine

S.No.	SECTION	COST
1.	Cutting and sealing Section	Rs.5000
2.	Feeding and Delivery Section	Rs. 10000
3.	Total	Rs. 15000

Running Speed of the Machine - 2 dpm (diaper per minute)

4.4. Diaper Cost:

Table.4. Material Cost of the Developed Diaper

MATERIAL	COST(Rs.)
Nonwoven	0.25
Polypropylene sheet	0.10
Absorbent core(wood pulp)	0.25
Super absorbent polymer	0.50
Stickers and lycra filament	0.40
Total	1.50

FUTURE SCOPE

5. Future scope

- The present semi-automatic machine can further be automated by giving drive to the feed and delivery rollers through a servo motor.
- In the cutting section instead of hand pressing, it can be pressed by means of a pedal which can be provided through a leverage system. This greatly reduces the human force required to press.
- If the machine is automated in this way, the efficiency would be greatly increased and the running speed can be made up to 10dpm (diaper per minute).

CONCLUSION

6. CONCLUSION

Thus we have made a semi-automatic baby diaper machine at a very low cost of Rs. 15000 as against Rs. 1 crore of that of an automated one available in the market. Out of this machine we have also produced the diaper at a low cost and it is less than Rs.2.

The cost of the machine is greatly reduced by making the manufacturing process of the diaper a batch wise process instead of a continuous process. Further the feeding and delivery sections are operated manually. This has greatly reduced the cost of the machine. Whereas the cutting and sealing section of the machine is an automated one.

The component structure of the disposable diaper has also been modified in order to reduce its cost.

Since the diaper's cost is less, the rural people and lower middle class people would be able to afford these diapers and this will greatly increase their hygiene level.

Since the machine cost is less rural women would be able to buy these machines. They can become entrepreneurs by manufacturing and marketing the diapers made out of these machines through self help groups and this would greatly help to enhance their standard of living.

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7. REFERENCES

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